

# WINP 2015 Draft Agenda: Theory Perspective

*K.S. Babu and Mu-Chun Chen*  
*Theory Session Convenors*

## *Agenda:*

- 1:30–2:00pm: Discussion on  $3\text{-}\nu$  oscillation paradigm
- 2:00–2:30pm: Short baseline neutrino anomalies
- 2:30–3:00pm: Supernova neutrinos
- 3:00–3:30pm: Coffee break
- 3:30–4:00pm: Neutrino telescopes: Physics and astrophysics
- 4:00–4:30pm: Neutrino masses and physics beyond the Standard Model
- 4:30–5:00pm: Discussion on neutrino interactions
- 5:00–5:30pm: Discussion on neutrinoless double beta decay

*What are the most interesting questions about whose answers we can learn a lot from near-term future experiments (i.e., before LBN\* goes online)?*

- *Dirac versus Majorana nature of the neutrino:* Improved searches for neutrinoless double beta decay is the best bet to address this fundamental question. Inverted neutrino spectrum may be within reach in such experiments.
- *Direct neutrino mass measurement:* Determining the absolute neutrino mass scale in Tritium beta decay experiments would provide deep insight into the origin of neutrino masses.
- *Sensitivity to mass hierarchy and possibly CP violation:* Any progress towards measuring the neutrino mass hierarchy before LBN\* would be highly desirable. In particular, knowing the hierarchy is crucial for the possibility of obtaining a hint for the value of the leptonic CP violating phase prior to ELBNF.
- *Consistency checks of the three neutrino oscillation paradigm:* This requires a variety experimental information including:

- Improved knowledge of neutrino oscillation parameters from solar, atmospheric, and reactor neutrino experiments.
  - Essential information on neutrino interaction rates from experiments.
- *Neutrino interactions*: Knowing the interaction rates is crucial for addressing many of the important questions in neutrino physics, including the consistency checks of the three neutrino oscillation paradigm.
  - *Understanding anomalies seen in short baseline experiments*: Unambiguous resolution in terms of oscillations would require seeing  $L/E$  dependence in new/upgraded experiments.
  - *Existence of sterile neutrino*: Discovery of new sterile states in neutrino oscillation experiments attempting to resolve short baseline anomalies will be foundational.
  - *Nonstandard neutrino interactions*: If discovered, these effects would invalidate the three neutrino oscillation paradigm, and hint at new physics beyond neutrino masses.
  - *Supernova neutrinos*: Nearby supernova explosions can show neutrino signals any time, watching out for them can pay hefty dividends.
  - *High energy astrophysical neutrinos*: IceCube and its upgrade will tell us more about the origin of very high energy (PeV scale) astrophysical neutrinos. Energy spectrum, directional information, and flavor composition of these events can help us understand the astrophysical sources as well as neutrino properties.
  - *Neutrinos in cosmology*: Although indirect, neutrino masses inferred from cosmology would provide complementary information, and at the same time also test standard cosmological models.
  - *Neutrino masses and physics beyond the Standard Model*: What can neutrino experiments teach us about the underlying symmetries of the theory that generates neutrino masses?
  - *Nucleon decay*: Ongoing large underground detectors (SuperKamiokande) which are sensitive to neutrino oscillation physics continue to be also sensitive to nucleon decay. Discovery of nucleon decay would be monumental.
  - *Exotic neutrino properties*: Information on neutrino properties such as its magnetic moment, decay lifetime, and possible violations of Lorentz invariance and/or CPT invariance would be valuable. Do neutrinos interact with dark matter? Even if not found, neutrinos can provide some of the best tests of these fundamental symmetries.